Memory

Chapter 6

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Chapter 6 Learning Objective Menu

- LO 6.1 Memory and the three processes of memory
- LO 6.2 Different models of how memory works
- LO 6.3 Sensory memory
- LO 6.4 Short-term or working memory
- LO 6.5 Long-term memory
- LO 6.6 Different types of long-term memory
- LO 6.7 How information is organized in long-term memory
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- LO 6.13 Problems experienced with remembering a long-term memory
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- LO 6.15 Different causes of forgetting
- LO 6.16 How and where memories are formed in the brain
- LO 6.17 Amnesia
- LO 6.18 Helping people with Alzheimer's disease

Memory and Its Processes

- Memory - an active system that receives information from the senses, organizes and alters it as it stores it away, and then retrieves the information from storage.
- Processes of Memory:
  - Encoding - the set of mental operations that people perform on sensory information to convert that information into a form that is usable in the brain's storage systems.
  - Storage - holding onto information for some period of time.
  - Retrieval - getting information that is in storage into a form that can be used.

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Models of Memory

- Information-processing model - model of memory that assumes the processing of information for memory storage is similar to the way a computer processes memory in a series of three stages.
  - Levels-of-processing model - model of memory that assumes information that is more "deeply processed," or processed according to its meaning rather than just the sound or physical characteristics of the word or words, will be remembered more efficiently and for a longer period of time.
  - Parallel distributed processing (PDP) model - a model of memory in which memory processes are proposed to take place at the same time over a large network of neural connections.

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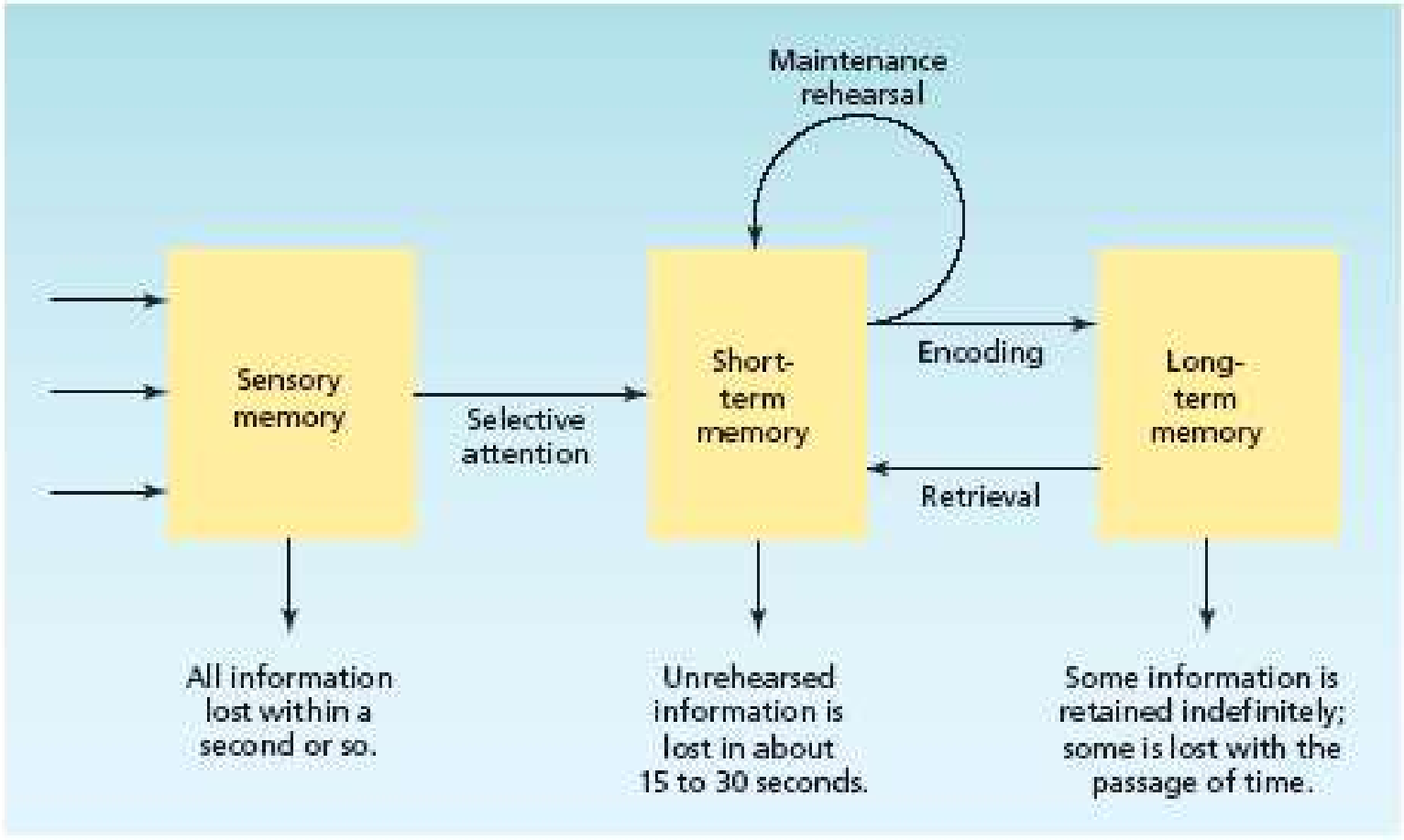
LO 6.2 Different models of how memory works

FIGURE 6.1 **Three-Stage Process of Memory** Information enters through the sensory system, briefly registering in sensory memory. Selective attention moves the information into short-term memory, where it is held while attention (rehearsal) continues. If the information receives enough rehearsal, it will enter and be stored in long-term memory.


Maintenance rehearsal
Sensory memory
Selective attention
Short-term memory
Encoding
Long-term memory
Retrieval
All information lost within a second or so.
Unrehearsed information is lost in about 15 to 30 seconds.
Some information is retained indefinitely; some is lost with the passage of time.

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Sensory Memory

- Sensory memory - the very first stage of memory, the point at which information enters the nervous system through the sensory systems.
  - Iconic memory - visual sensory memory, lasting only a fraction of a second.
    - Capacity – everything that can be seen at one time.
    - Duration - information that has just entered iconic memory will be pushed out very quickly by new information, a process called masking.
    - Eidetic imagery - the rare ability to access a visual memory for 30 seconds or more.

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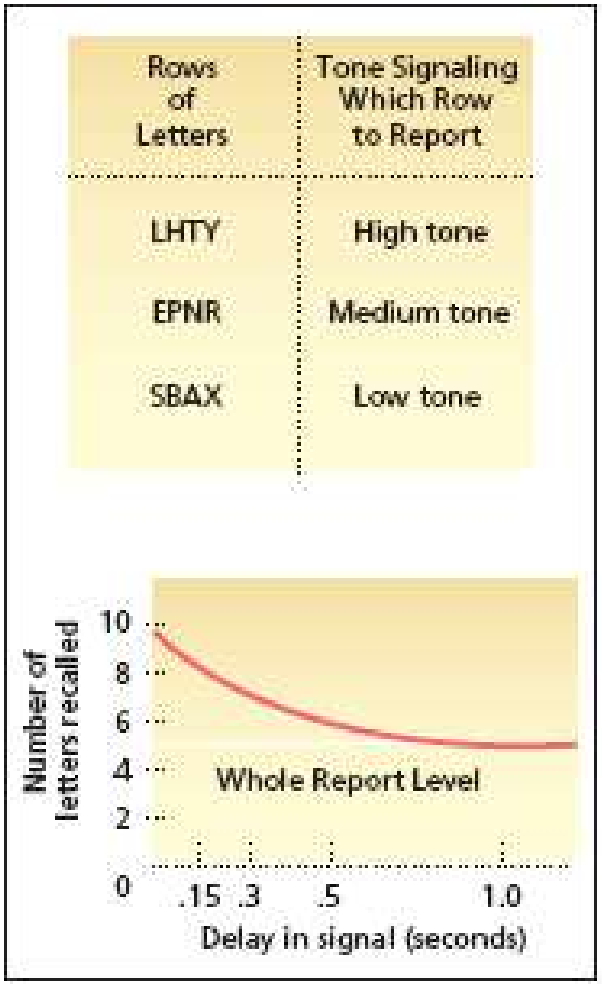
LO 6.3 Sensory memory

FIGURE 6.2 **Iconic Memory Test**
Sample grid of letters for Sperling's test of iconic memory. To determine if the entire grid existed in iconic memory, Sperling sounded a tone associated with each row after the grid's presentation. Participants were able to recall the letters in the row for which they heard the tone. The graph shows the decrease in the number of letters recalled as the delay in presenting the tone increased.



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Sensory Memory

- Echoic memory - the brief memory of something a person has just heard.
  - Capacity - limited to what can be heard at any one moment and is smaller than the capacity of iconic memory
  - Duration – lasts longer that iconic — about 2 to 4 seconds

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Short-Term Memory

- Short-term memory (STM) (working memory) - the memory system in which information is held for brief periods of time while being used.
  - Selective attention – the ability to focus on only one stimulus from among all sensory input.

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Short-Term Memory

- Digit-span test – memory test in which a series of numbers is read to subjects in the experiment who are then asked to recall the numbers in order.
  - Conclusions are that the capacity of STM is about seven items or pieces of information, plus or minus two items, or from five to nine bits of information.
    - "magical number" = 7

- Chunking – bits of information are combined into meaningful units, or chunks, so that more information can be held in STM.

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Short-Term Memory

- Maintenance rehearsal - practice of saying some information to be remembered over and over in one's head in order to maintain it in short-term memory (STMs tend to be encoded in auditory form).
- Duration of STM - lasts from about 12 to 30 seconds without rehearsal.

- STM is susceptible to interference (e.g., if counting is interrupted, have to start over).

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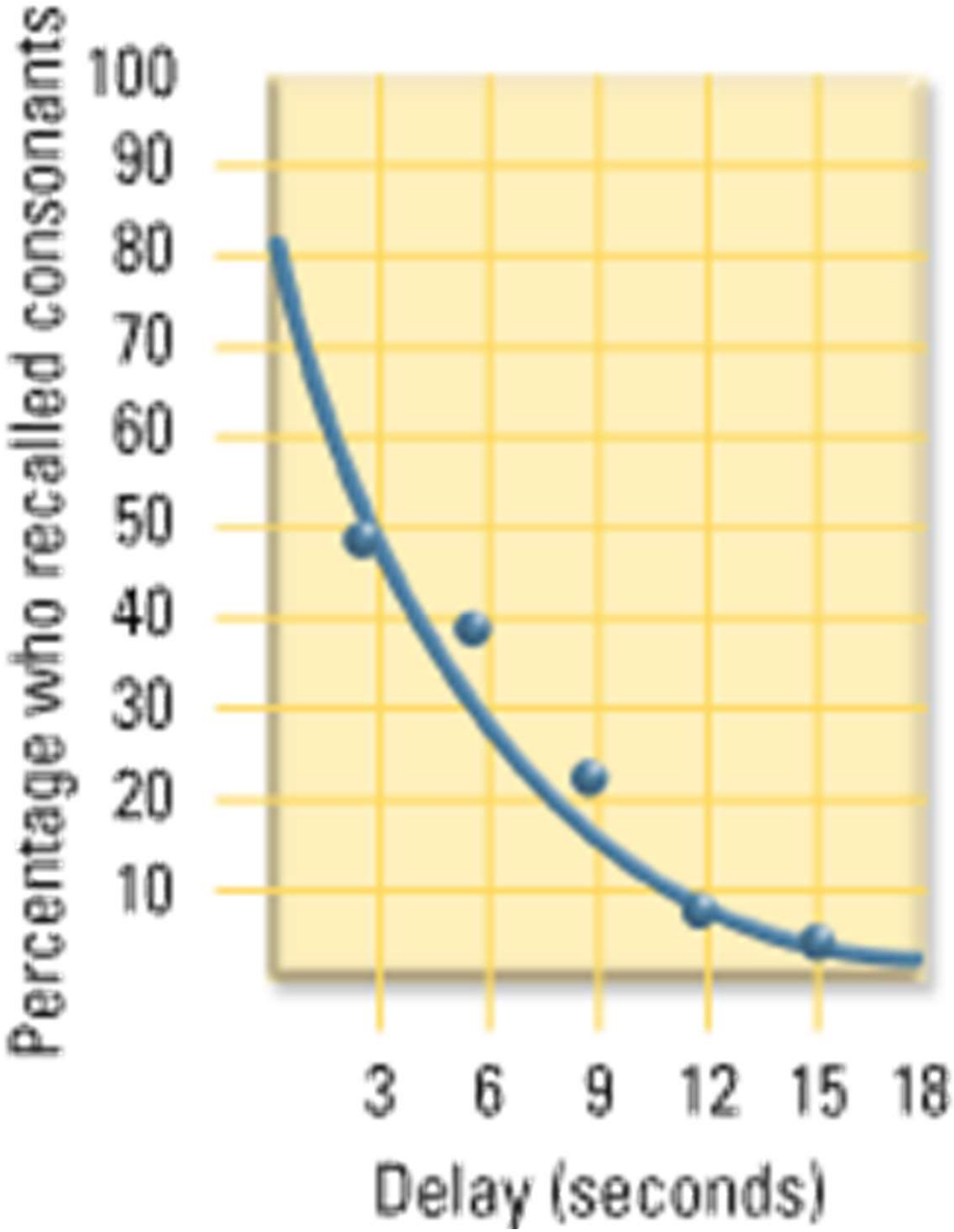
Percentage who recalled consonants
100
90
80
70
60
50
40
30
20
10
3
6
9
12
15
18
Delay (seconds)

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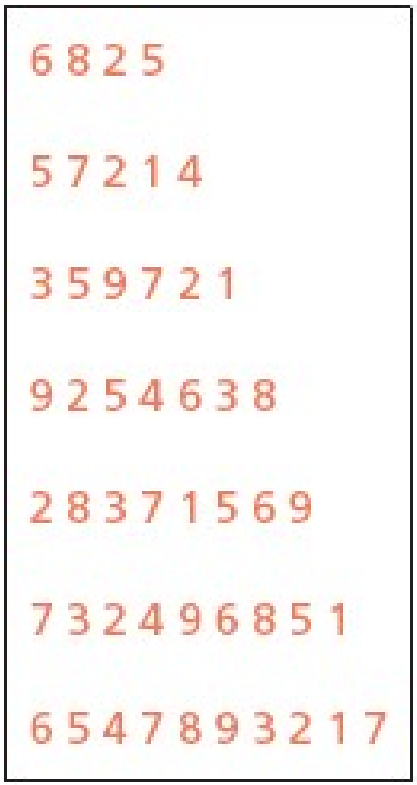
LO 6.4 Short-term or working memory

FIGURE 6.3 **Digit-Span Test**
Instructions for the digit-span test: Listen carefully as the instructor reads each string of numbers out loud. As soon as each string is ended (the instructor may say "go"), write down the numbers in the exact order in which they were given.



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Long-Term Memory

- Long-term memory (LTM) - the system of memory into which all the information is placed to be kept more or less permanently.
- Elaborative rehearsal - a method of transferring information from STM into LTM by making that information meaningful in some way.

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Types of LTM

- Procedural (nondeclarative) memory - type of long-term memory including memory for skills, procedures, habits, and conditioned responses. These memories are not conscious but are implied to exist because they affect conscious behavior.
- Declarative memory – type of long-term memory containing information that is conscious and known (memory for facts).

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Procedural (Nondeclarative) LTM

- Skills that people know how to do.
- Also include emotional associations, habits, and simple conditioned reflexes that may or may not be in conscious awareness.
- Anterograde amnesia - loss of memory from the point of injury or trauma forward, or the inability to form new long-term memories. Usually does NOT affect procedural LTM.
- Procedural memory often called implicit memory - memory that is not easily brought into conscious awareness.

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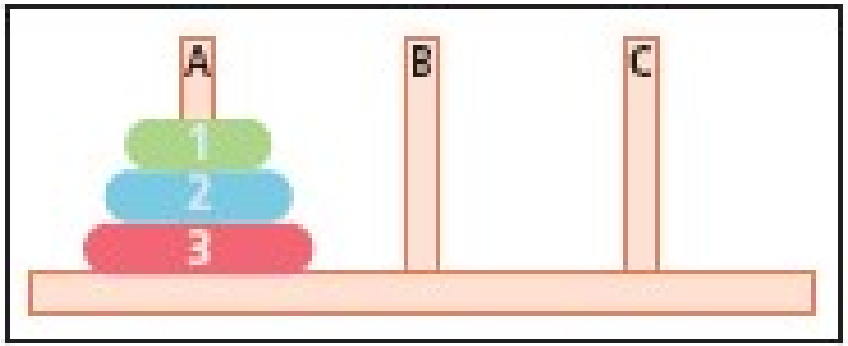
LO 6.6 Different types of long-term memory

FIGURE 6.4 **Tower of Hanoi**
The Tower of Hanoi is a puzzle that is solved in a series of steps by moving one disk at a time. A larger disk can never be moved on top of a smaller one. Amnesia patients were able to learn the procedure for solving the puzzle but could not remember that they knew how to solve it.



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Declarative LTM

- All the things that people know.
- Semantic memory - type of declarative memory containing general knowledge, such as knowledge of language and information learned in formal education.
- Episodic memory - type of declarative memory containing personal information not readily available to others, such as daily activities and events.
- Semantic and episodic memories are forms of explicit memory - memory that is consciously known.

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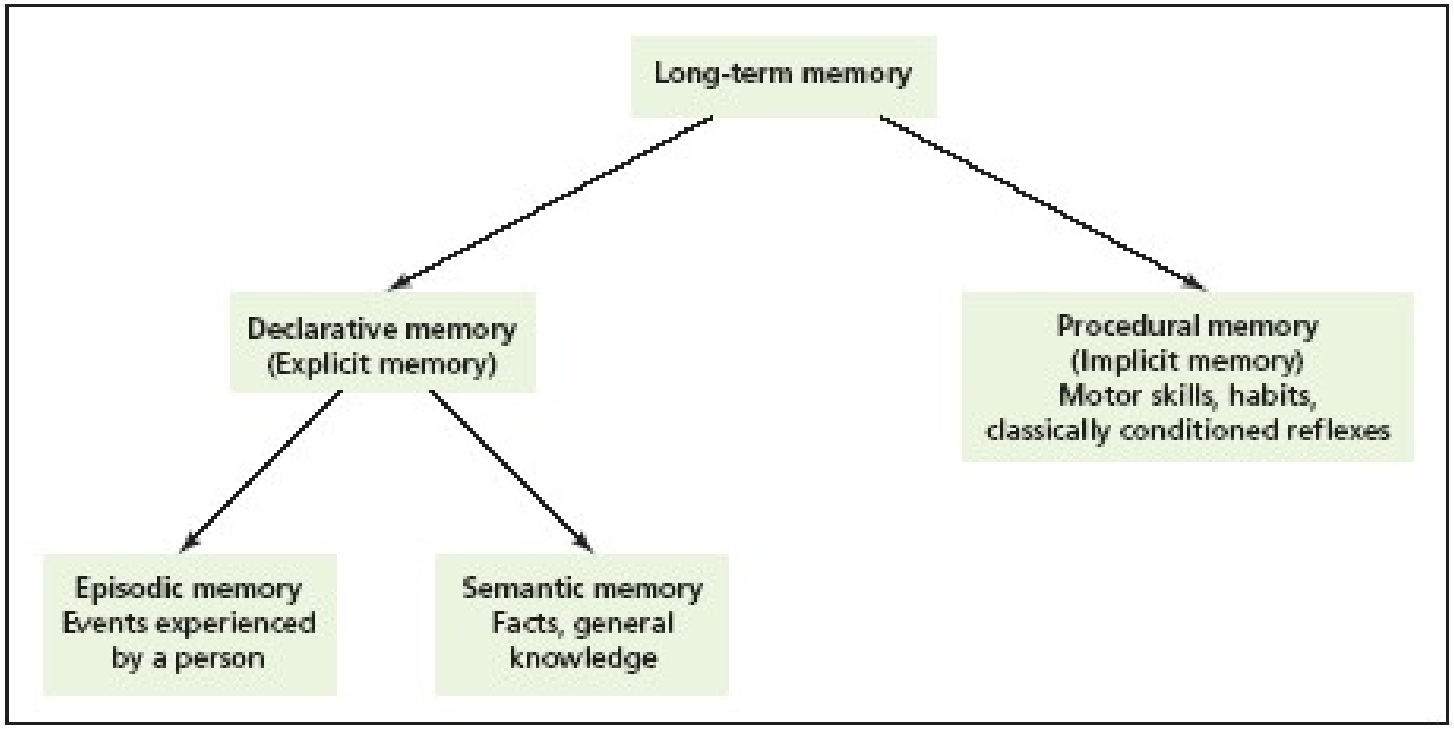
LO 6.6 Different types of long-term memory

FIGURE 6.5 **Types of Long-Term Memories** Long-term memory can be divided into declarative memories, which are factual and typically conscious (explicit) memories, and nondeclarative memories, which are skills, habits, and conditioned responses that are typically unconscious (implicit). Declarative memories are further divided into episodic memories (personal experiences) and semantic memories (general knowledge).



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Organization of Memory

- LTM organized in terms of related meanings and concepts.
- Semantic network model - model of memory organization that assumes information is stored in the brain in a connected fashion, with concepts that are related stored physically closer to each other than retrieval cue a stimulus for remembering.

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LO 6.7 How information is organized in long-term memory

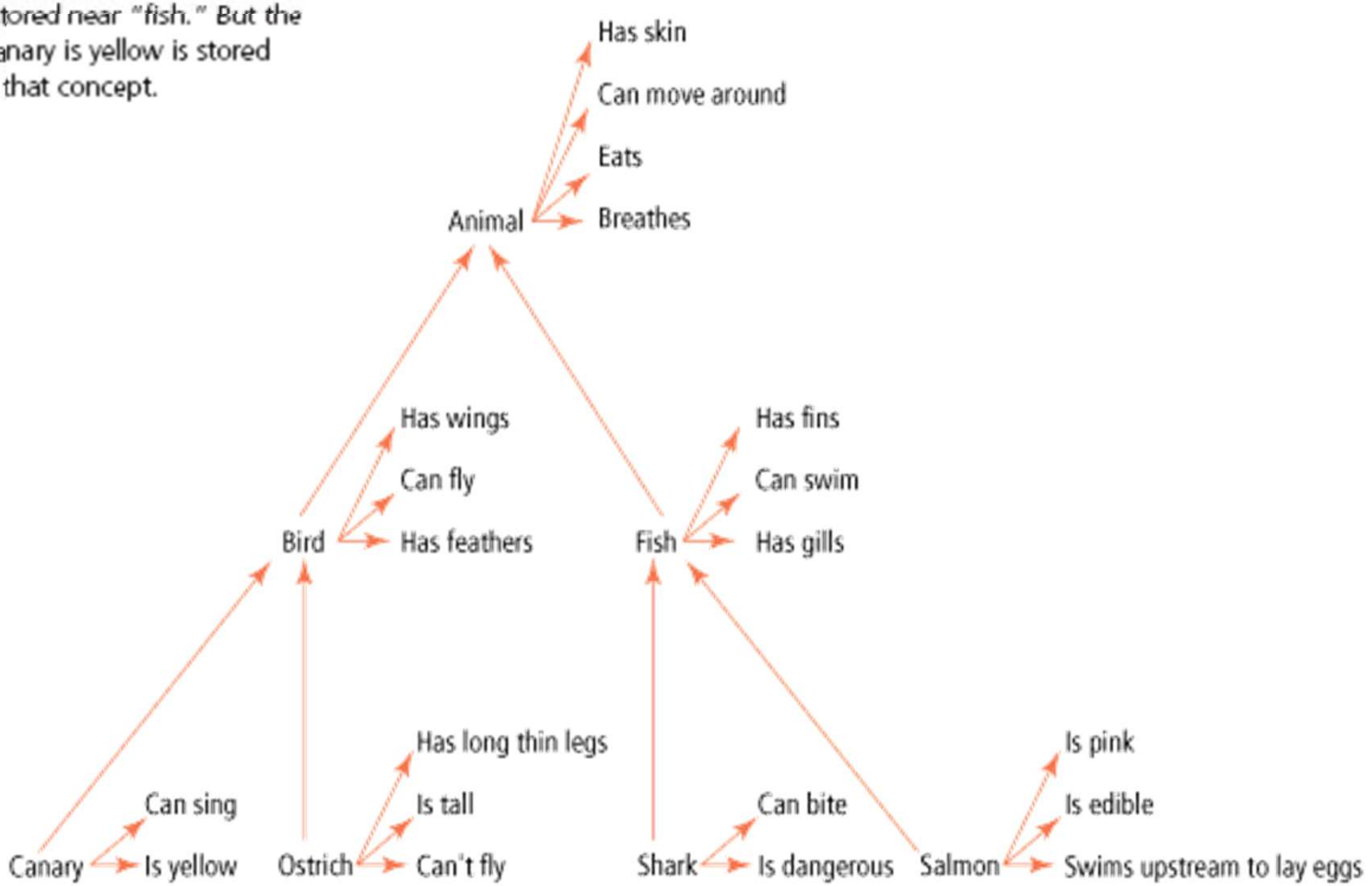

FIGURE 6.6 **An Example of a Semantic Network** In the semantic network model of memory, concepts that are related in meaning are thought to be stored physically near each other in the brain. In this example, canary and ostrich are stored near the concept node for "bird" whereas shark and salmon are stored near "fish." But the fact that a canary is yellow is stored directly with that concept.

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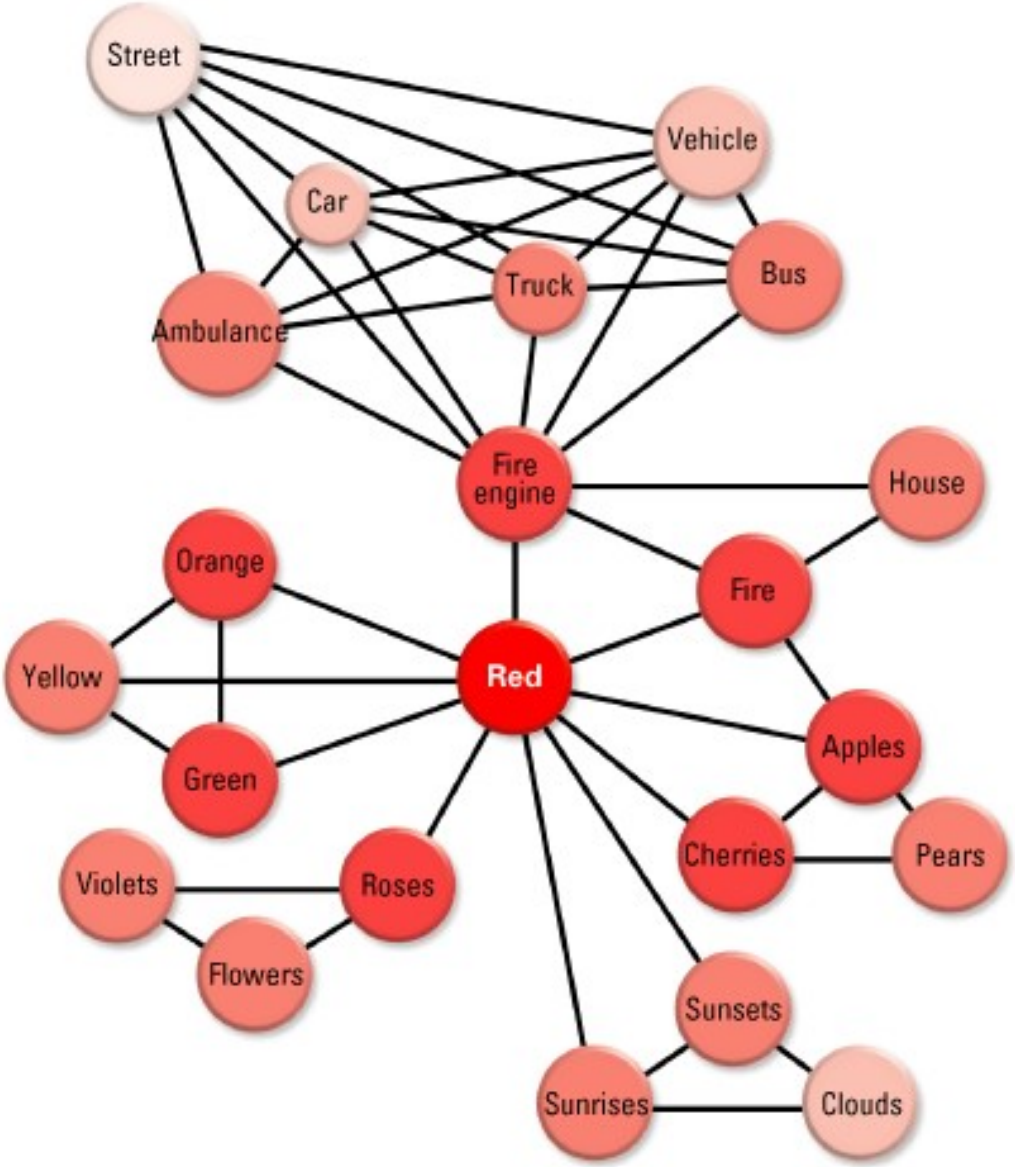
LO 6.7 How information is organized in long-term memory



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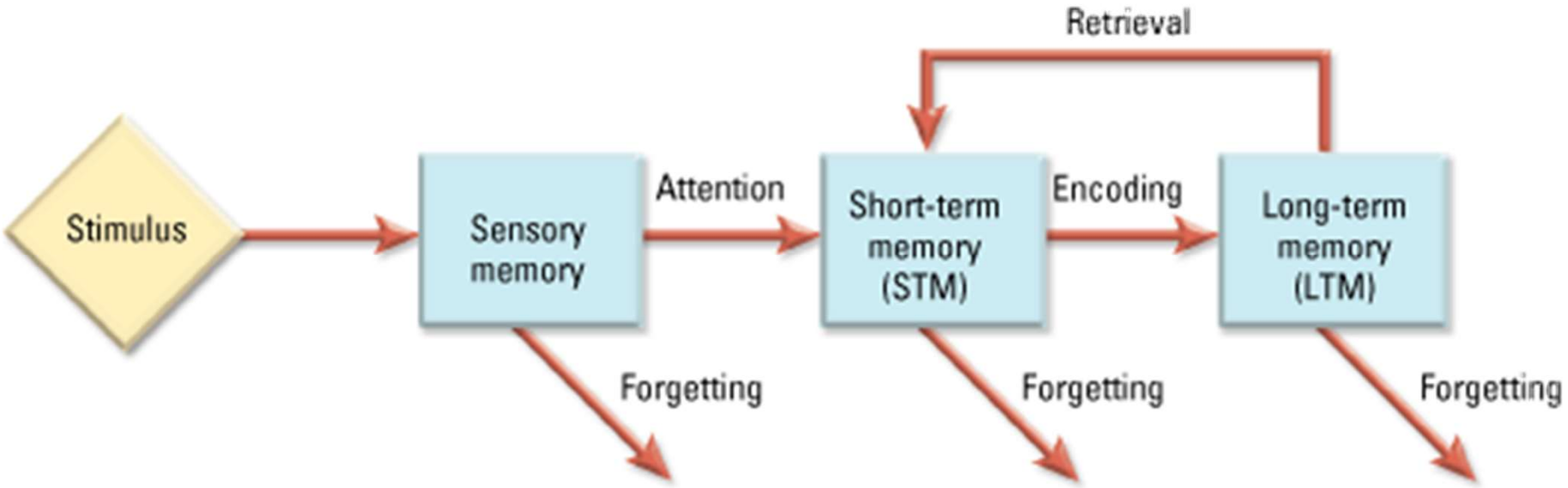
LO 6.7 How information is organized in long-term memory



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Cues to Help Remember

- Retrieval cue – a stimulus for remembering.
- Encoding specificity - the tendency for memory of information to be improved if related information (such as surroundings or physiological state) available when the memory is first formed is also available when the memory is being retrieved.
  - *State-dependent learning* - memories formed during a particular physiological or psychological state will be easier to recall while in a similar state.

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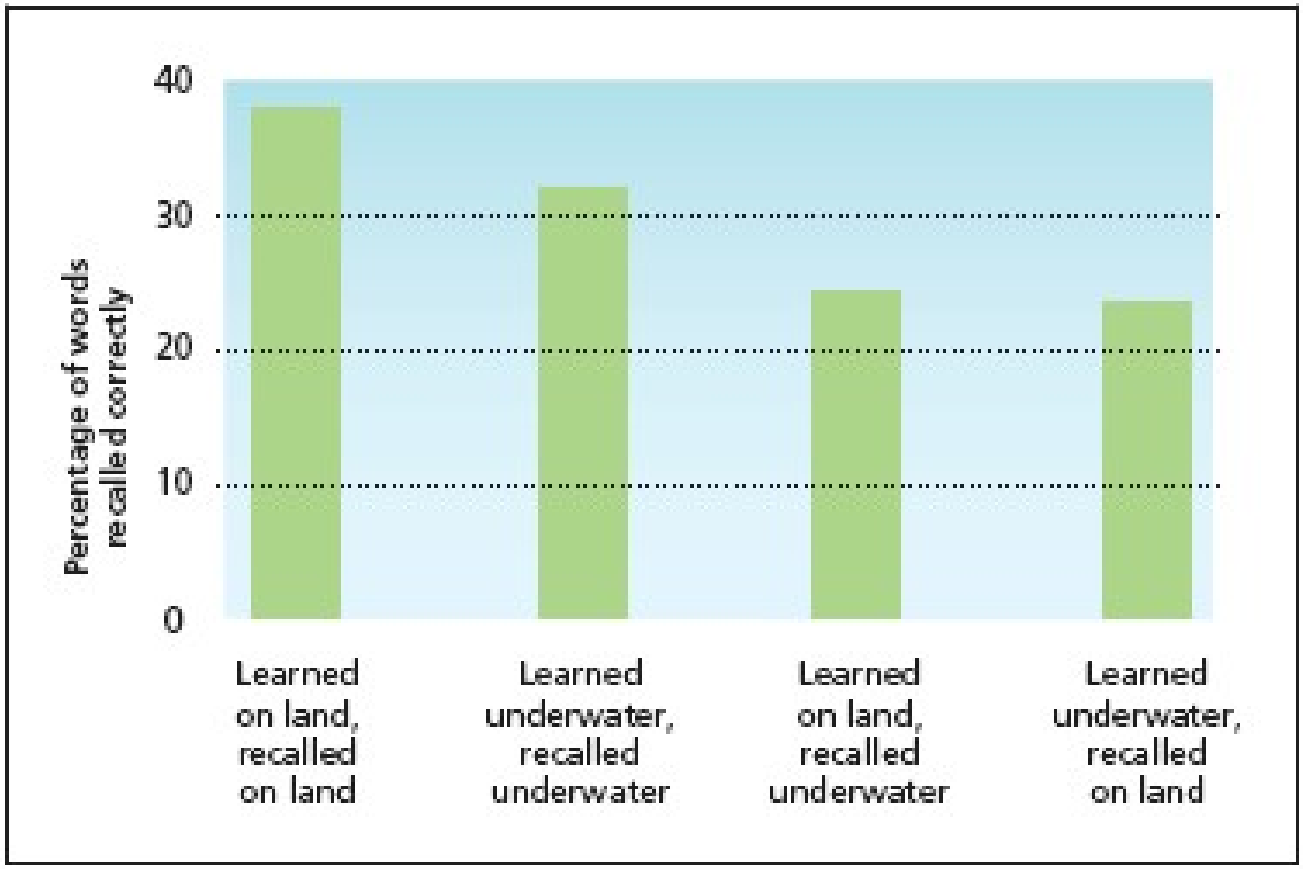
FIGURE 6.7 **Recall of Target Words In Two Contexts** Memory the retrieval of words learned while under water was higher when the retrieval also took place under water. Similarly, words learned while out of the water (on land) were retrieved at a higher rate out of the water.

LO 6.8 Kinds of cues that help people remember



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LO 6.9 How recall and recognition differ

Recall

- Recall - type of memory retrieval in which the information to be retrieved must be "pulled" from memory with very few external cues.
  - Retrieval failure – recall has failed (at least temporarily).
    - Tip of the tongue phenomenon.

WELL, FOR CRYING OUT LOUD! AL TOWBRIDGE! WHAT IS IT, NINE YEARS, SEVEN MONTHS, AND TWELVE DAYS SINCE I LAST RAN INTO YOU? TEN-THIRTY-TWO A.M., A SATURDAY, FELCHER'S HARDWARE STORE. YOU WERE BUYING SEALER FOR YOUR BLACKTOP DRIVEWAY. TELL ME, AL, HOW DID THAT SEALER WORK? DID IT HOLD UP?
MR. TOTAL RECALL
WMiller
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Recall

- Serial position effect - tendency of information at the beginning and end of a body of information to be remembered more accurately than information in the middle of the body of information.
  - Primacy effect - tendency to remember information at the beginning of a body of information better than the information that follows.
  - Recency effect - tendency to remember information at the end of a body of information better than the information ahead of it.

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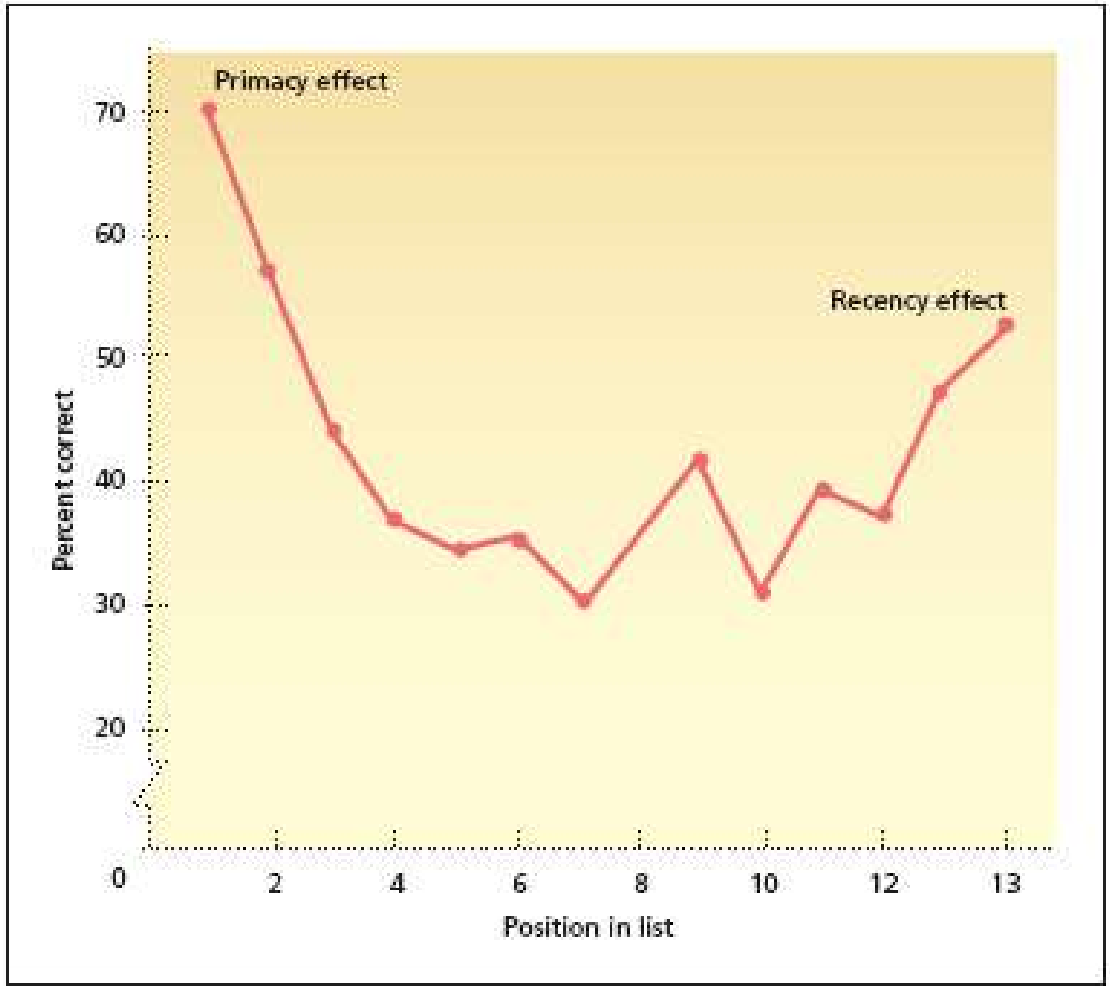
FIGURE 6.8 **Serial Position Effect**
In the serial position effect, information at the beginning of a list will be recalled at a higher rate than information in the middle of the list (primacy effect) because the beginning information receives more rehearsal and may enter LTM. Information at the end of a list is also retrieved at a higher rate (recency effect) because the end of the list is still in STM, with no information coming after it to interfere with retrieval.

LO 6.9 How recall and recognition differ



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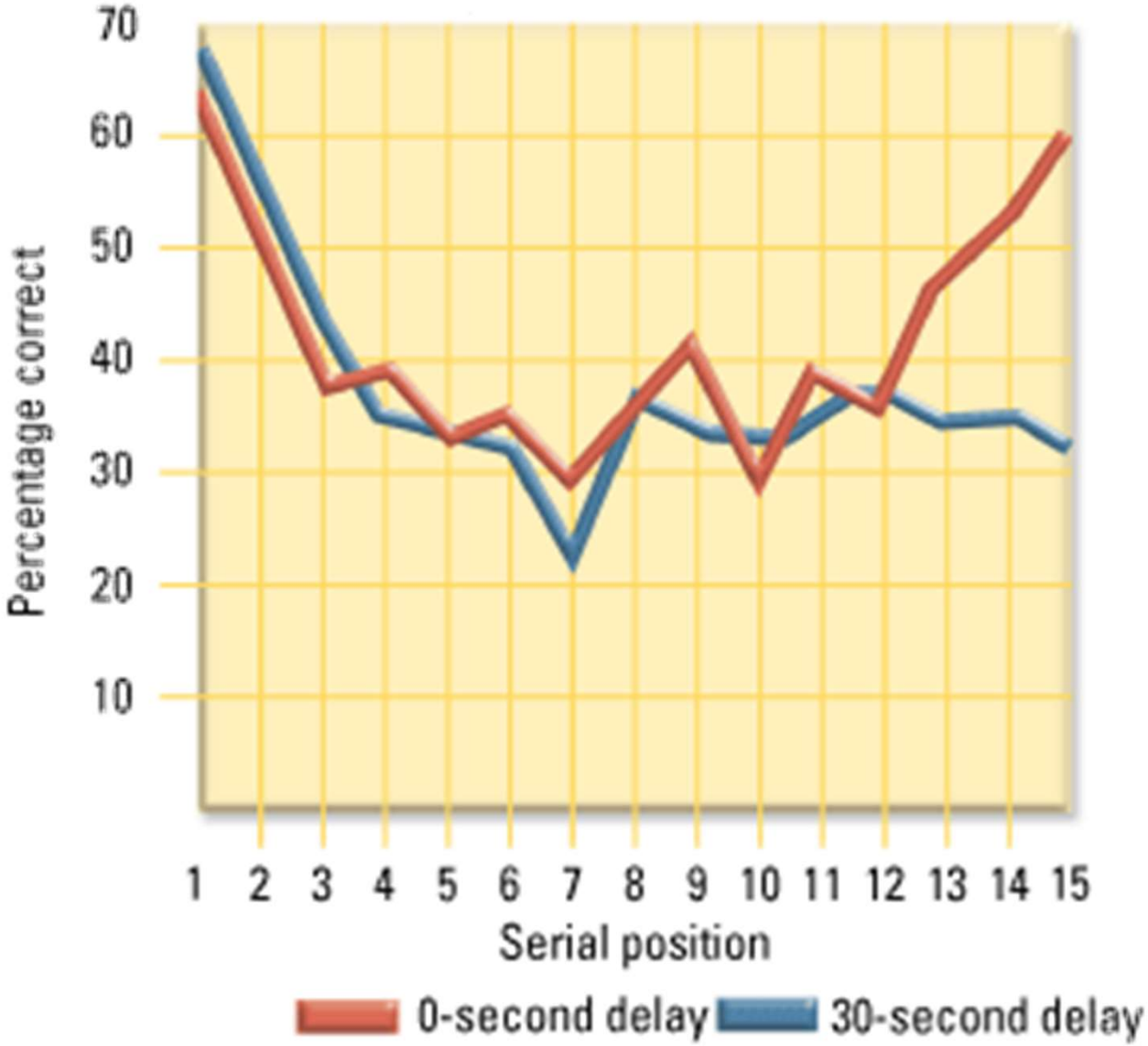
LO 6.9 How recall and recognition differ



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Recognition

- Recognition - the ability to match a piece of information or a stimulus to a stored image or fact.
- False positive – error of recognition in which people think that they recognize some stimulus that is not actually in memory.

Father Bernard Pagano enters a courthouse during his time as a suspect in a series of robberies. He was falsely identified for the crimes committed by another man, who eventually confessed to the robberies. False positives occur when people mistakenly believe they have recognized someone or something that they have actually never seen.

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Eyewitness Testimony

- Elizabeth Loftus study.
  - Showed that what people see and hear about an event after the fact can easily affect the accuracy of their memories of that event.
  - Eye witness testimony not always reliable.

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Automatic Encoding and Flashbulb Memories

- Automatic encoding - tendency of certain kinds of information to enter long-term memory with little or no effortful encoding.
- Flashbulb memories - type of automatic encoding that occurs because an unexpected event has strong emotional associations for the person remembering it.

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How LTMs Are Formed

- ". . . remembering is more like making up a story than it is like reading one printed in a book."
- Constructive processing - referring to the retrieval of memories in which those memories are altered, revised, or influenced by newer information.
- Hindsight bias - the tendency to falsely believe, through revision of older memories to include newer information, that one could have correctly predicted the outcome of an event.

Monday morning quarterbacking – hindsight bias

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Memory Retrieval Problems

- Misinformation effect - the tendency of misleading information presented after an event to alter the memories of the event itself.

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Reliability of Memory Retrieval

- False memory syndrome - the creation of inaccurate or false memories through the suggestion of others, often while the person is under hypnosis.
- Evidence suggests that false memories cannot be created for just any kind of memory.
  - The *memories* must at least be plausible.

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Forgetting

- Curve of forgetting - a graph showing a distinct pattern in which forgetting is very fast within the first hour after learning a list and then tapers off gradually.

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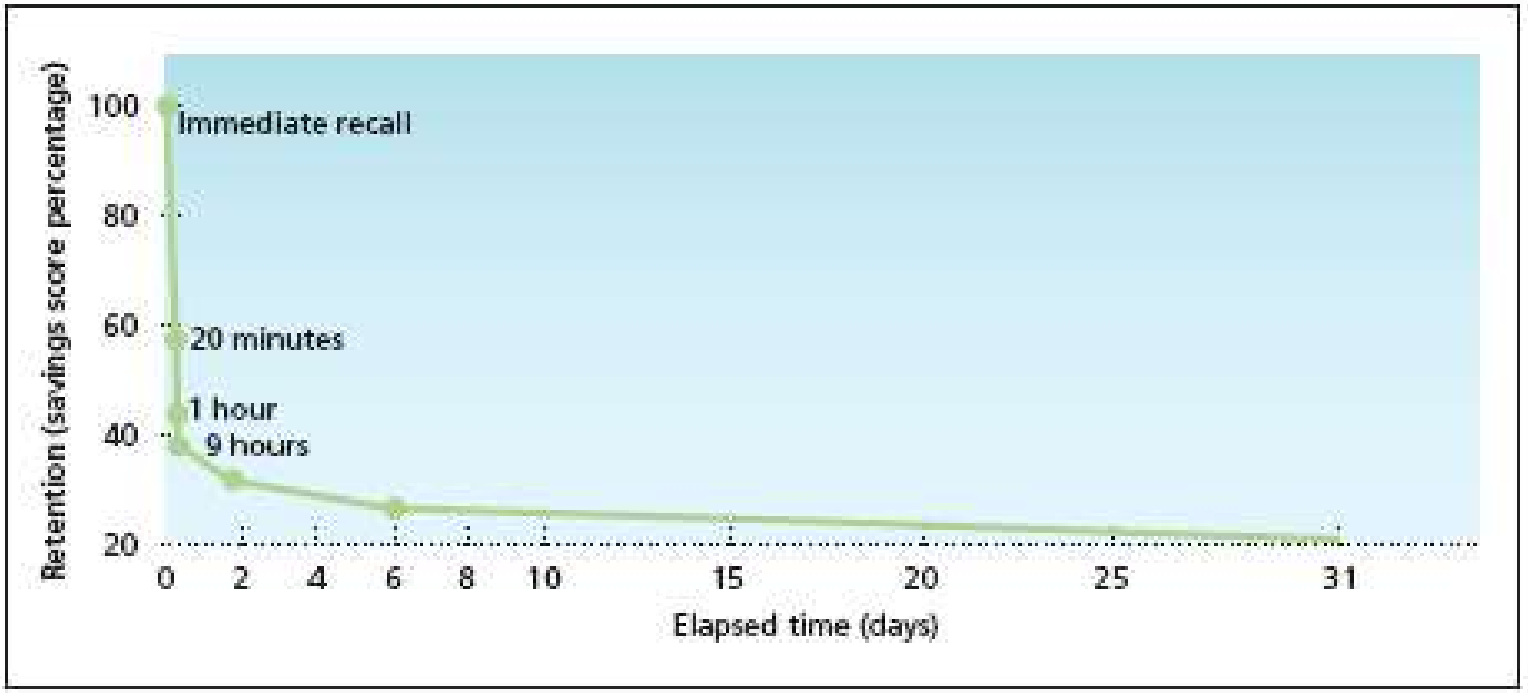
LO 6.15 Different causes of forgetting

FIGURE 6.9 **Curve of Forgetting**
Ebbinghaus found that his recall of words from his memorized word lists was greatest immediately after learning the list but rapidly decreased within the first hour. After the first hour, forgetting leveled off.



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Forgetting: Encoding Failure

- Encoding failure - failure to process information into memory.

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Encoding Failure: Which is the correct penny?

It's me!

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Forgetting: Memory Trace Theory

- Memory trace - physical change in the brain that occurs when a memory is formed.
  - Decay - loss of memory due to the passage of time, during which the memory trace is not used.
  - Disuse - another name for decay, assuming that memories that are not used will eventually decay and disappear.

Memories after many years – not explained by memory trace theory.

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Forgetting: Interference Theory

- Proactive interference - memory retrieval problem that occurs when older information prevents or interferes with the retrieval of newer information.
- Retroactive interference - memory retrieval problem that occurs when newer information prevents or interferes with the retrieval of older information.

Proactive interference – problem driving in England after learning in US.

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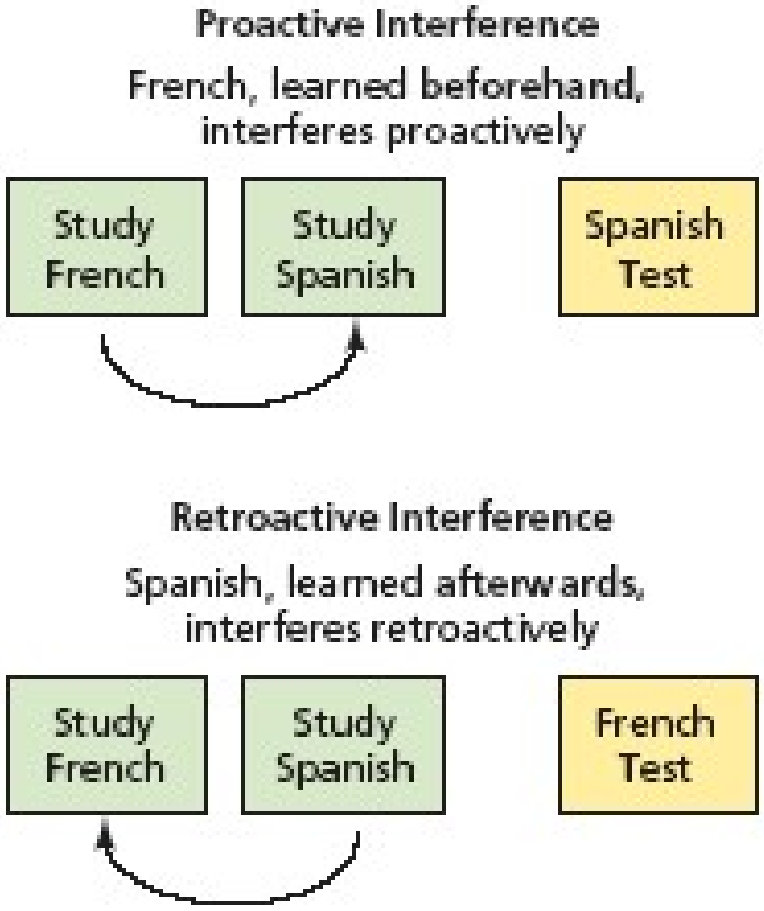
LO 6.15 Different causes of forgetting

FIGURE 6.11 **Proactive and Retroactive Interference** If a student were to study for a French exam and then a Spanish exam, interference can occur in two directions. When taking the Spanish exam, the French information studied first may proactively interfere with retrieval of the Spanish information. But when taking the French exam, the more recently studied Spanish information may retroactively interfere with the retrieval of the French information.



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LO 6.15 Different causes of forgetting

TABLE 6.1 TYPES OF FORGETTING

Type of Forgetting	Description
Encoding Failure	The information is not attended to and fails to be encoded.
Decay or Disuse	Information that is not accessed decays from the storage system over time.
Proactive Interference	Older information already in memory interferes with the retrieval of newer information.
Retroactive Interference	Newer information interferes with the retrieval of older information.

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Formation of LTMs

- Engram - the physical change that takes place in the brain when a memory is formed.
- Consolidation - the changes that take place in the structure and functioning of neurons when an engram is formed.
- Hippocampus – area of brain responsible for the formation of LTMs.

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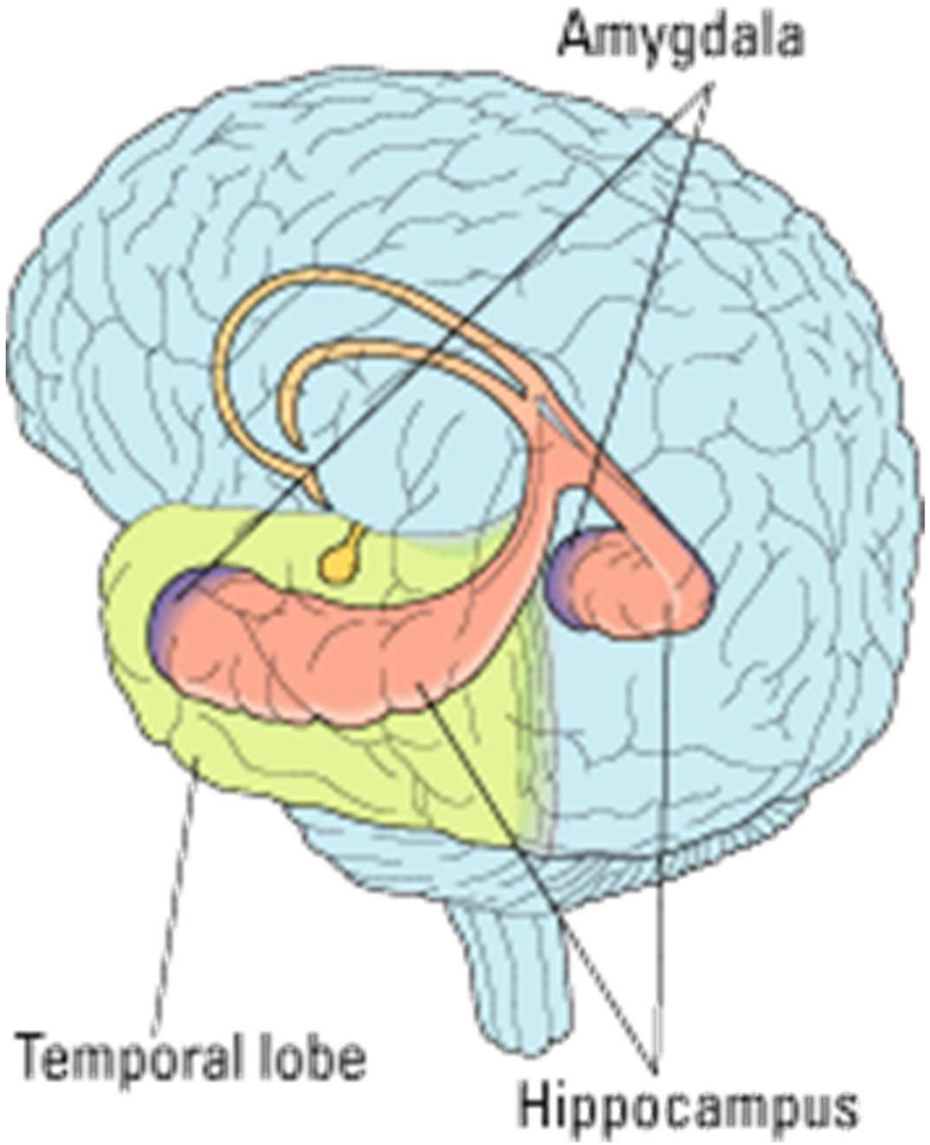
LO 6.16 How and where memories are formed in the brain



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Amnesia

- Retrograde amnesia - loss of memory from the point of some injury or trauma backwards, or loss of memory for the past.
- Anterograde amnesia - loss of memory from the point of injury or trauma forward, or the inability to form new long-term memories ("senile dementia").
- Infantile amnesia - the inability to retrieve memories from much before age 3.
  - Autobiographical memory - the memory for events and facts related to one's personal life story (usually after age 3).

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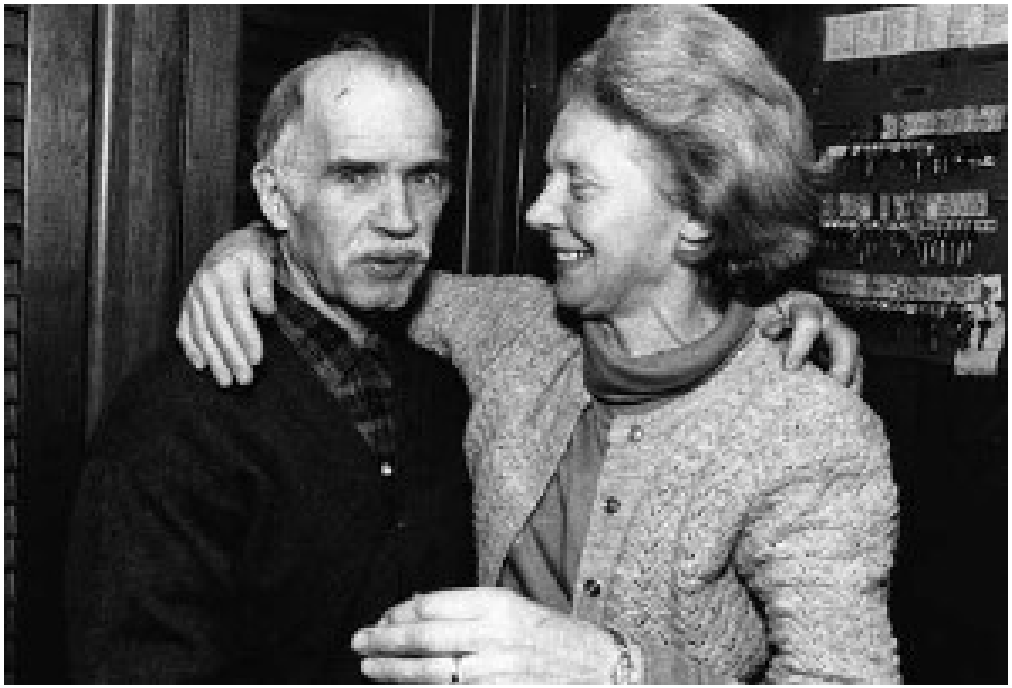
LO 6.17 Amnesia

On Christmas Day, 1985, James McDonnell came home to his wife in Larchmont, NY after 14 years of amnesia. He had lost his memory after suffering head injuries in two auto accidents. He had gone to Philadelphia, and had found a job in a restaurant. McDonnell said that his memory returned to him on Christmas Eve when he bumped his head.



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Alzheimer's Disease

- The primary memory difficulty in Alzheimer's is anterograde amnesia, although retrograde amnesia can also occur as the disease progresses.
- There are various drugs in use or in development for use in slowing or stopping the progression of Alzheimer's disease.

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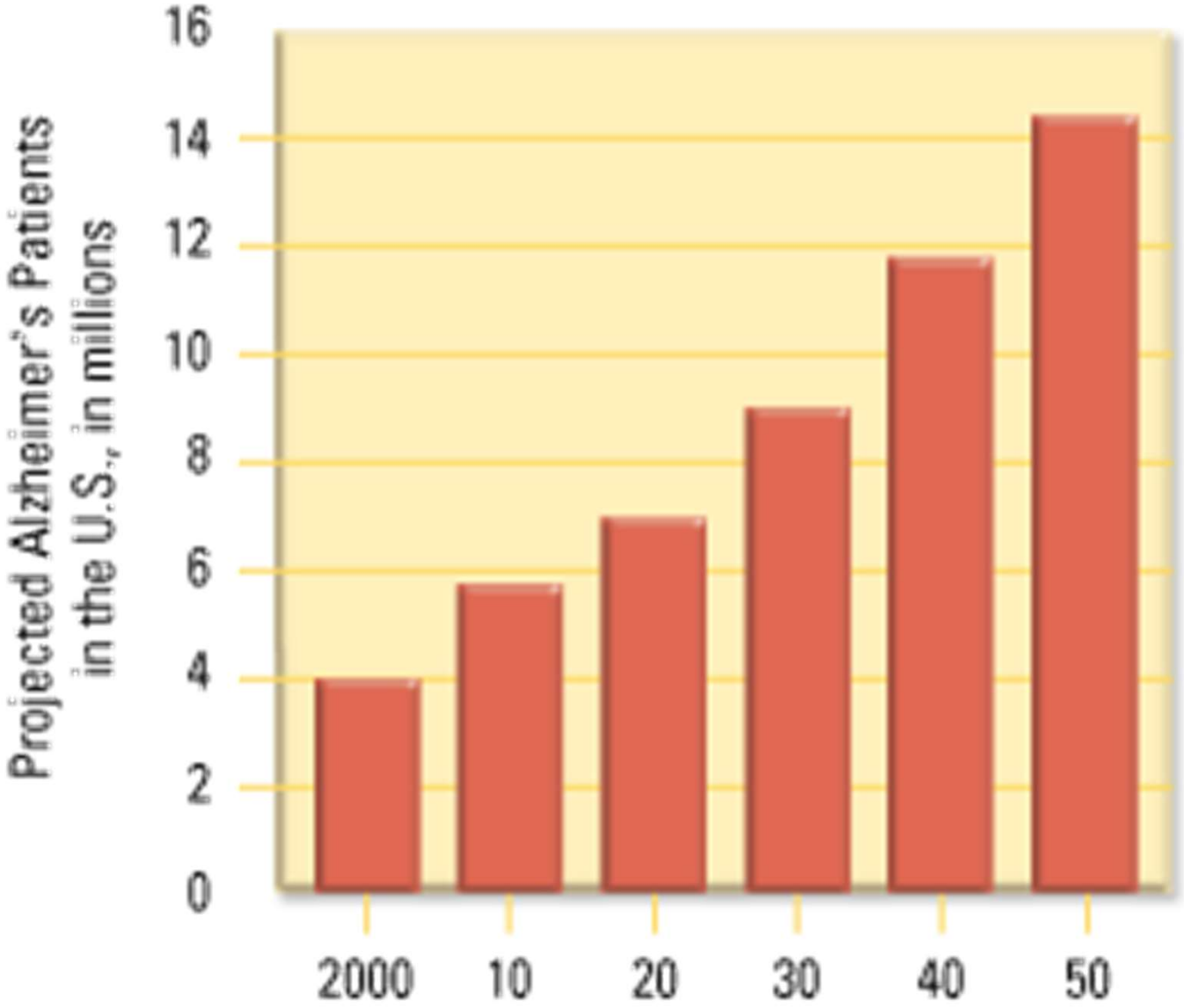
LO 6.18 Helping people with Alzheimer's disease



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